Points, Lines, and Planes

Florida's B.E.S.T. Standards for Mathematics

MA.912.GR.1.1

Prove relationships and theorems about lines and angles. Solve mathematical and real-world problems involving postulates, relationships and theorems of lines and angles.

Lesson Objectives

Content Objective

Students will analyze figures to identify points, lines, and planes and identify intersections of lines and planes.

Language Objectives

- Students explain how to identify points, lines, and planes and identify intersections of lines and planes using *can* and *cannot*.

Learn

Points, Lines, and Planes

Undefined Terms	
A **point** is a location. It has neither shape nor size. Named by a capital letter Example point *A*	
A **line** is made up of points and has no thickness or width. There is exactly one line through any two points. Named by the letters representing two points on the line or a lowercase script letter Example line m, line PQ or $\overleftrightarrow{PQ}$, line QP or $\overleftrightarrow{QP}$	

Learn

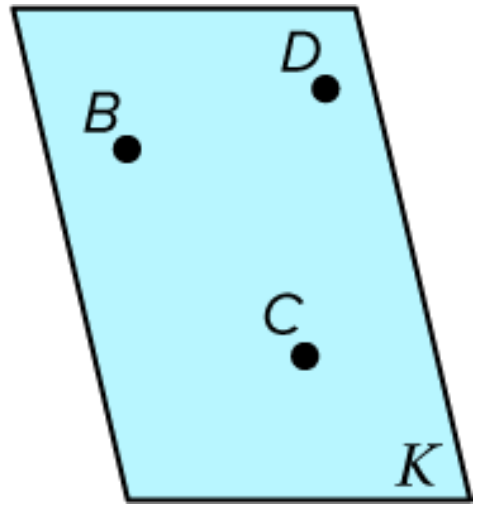
Points, Lines, and Planes

Undefined Terms

A **plane** is a flat surface made up of points that extends infinitely in all directions. There is exactly one plane through any three points not on the same line.

Named by a capital script letter or by the letters naming three points that are not all on the same line

Example plane $\mathcal{K}$, plane *BCD*, plane *CDB*, plane *DCB*, plane *DBC*, plane *CBD*, plane *BDC*

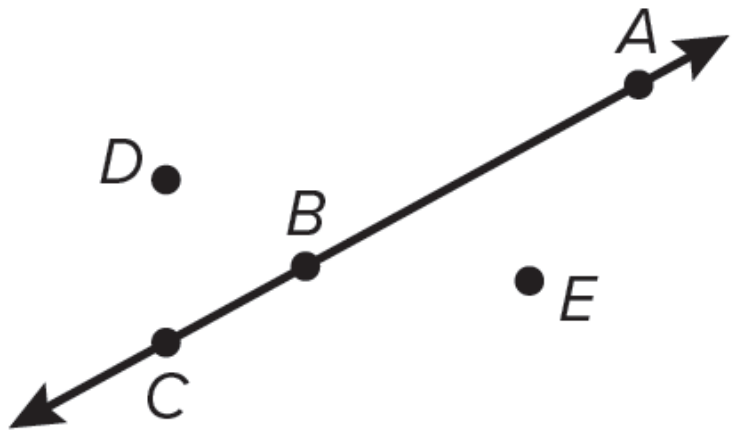


Learn

Points, Lines, and Planes

Space is defined as a boundless three-dimensional set of all points. Space can contain lines and planes.
Collinear points are points that lie on the same line.
Noncollinear points do not lie on the same line.

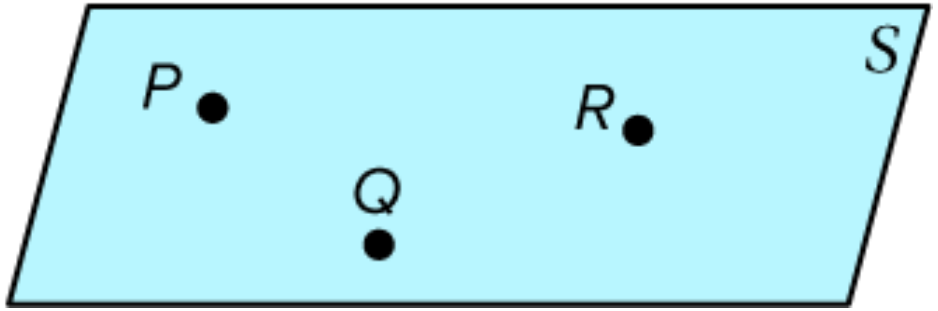
Points *A*, *B*, and *C* are collinear.



Learn

Points, Lines, and Planes

Coplanar points are points that lie in the same plane.
Noncoplanar points do not lie in the same plane.



Points *P*, *Q*, and *R* are coplanar in plane $\mathcal{S}$.

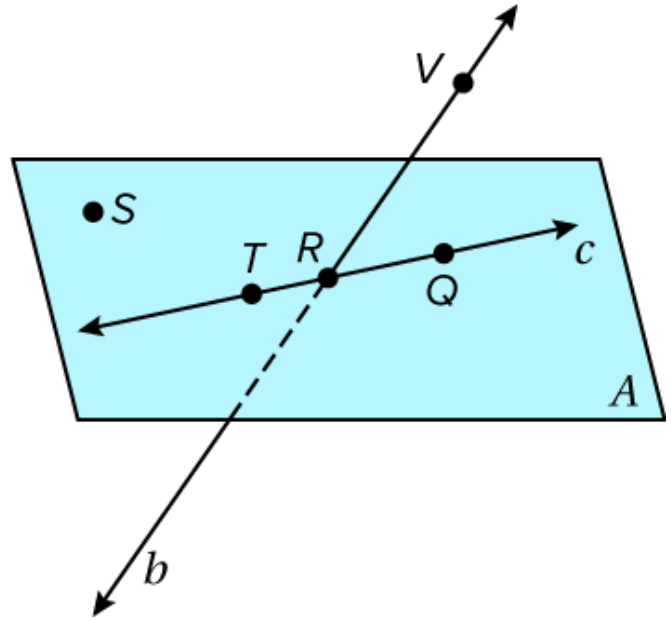
Example 1

Name Lines and Planes

Use the figure to name each of the following.

a. a line containing point *Q*

b. a plane containing point *S* and point *T*



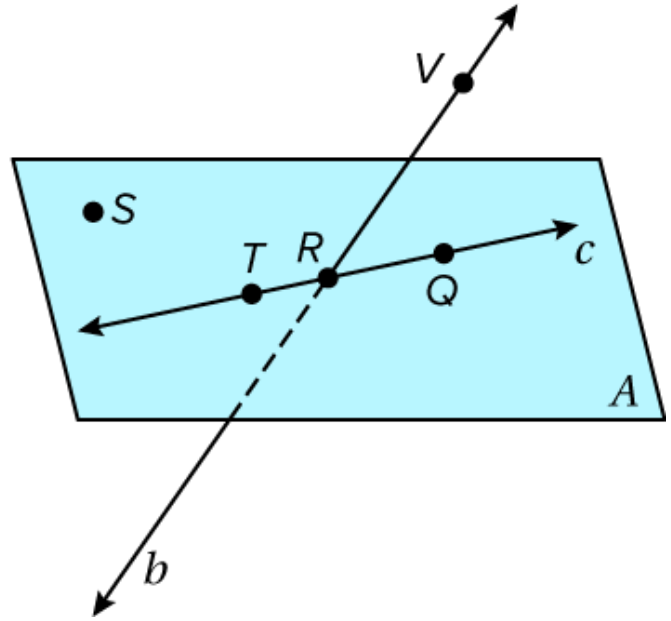
Example 1
Name Lines and Planes

a. a line containing point *Q*

The line can be named as line c, or any two of the three points on the line can be used to name the line.

Write the additional names for line c below.

$\overleftrightarrow{TR}, \overleftrightarrow{RT}, \overleftrightarrow{TQ}, \overleftrightarrow{QT}, \overleftrightarrow{RQ}, \overleftrightarrow{QR}$



Example 1
Name Lines and Planes

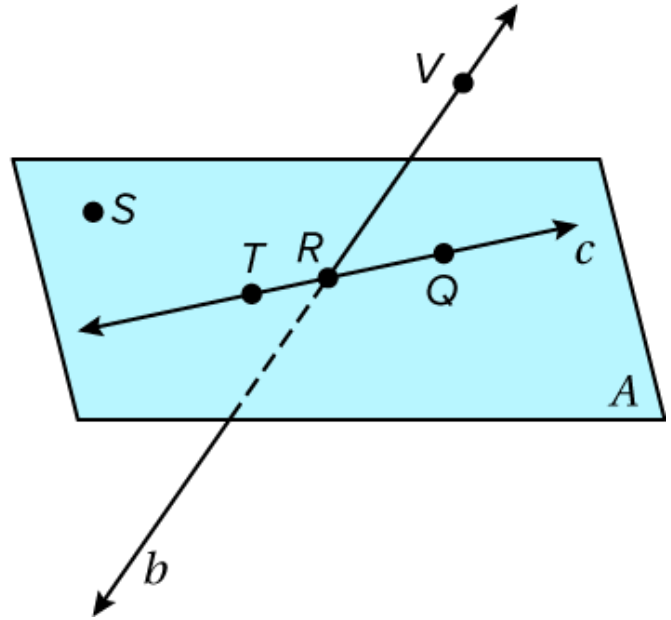
b. a plane containing point *S* and point *T*

One plane that can be named is plane $\mathcal{A}$. You can also use the letters of any three *noncollinear* points to name this plane.

Circle the other correct names for plane $\mathcal{A}$.

plane *QST* plane *STV* plane *TQS*

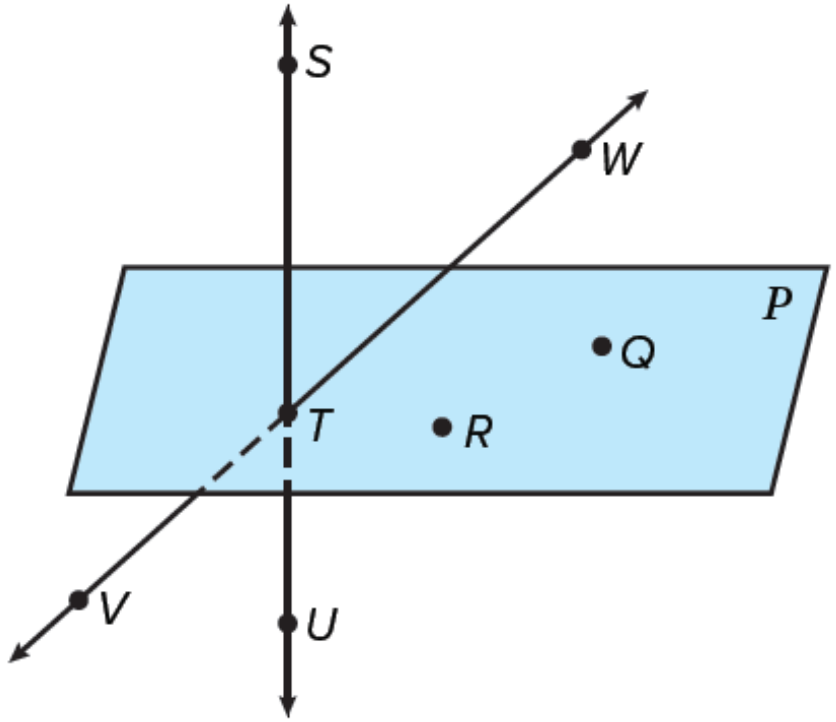
plane *QVS* plane *VST* plane *TRS*



Example 1
Name Lines and Planes

Check

Use the figure to name each of the following.



a. Identify the correct names for a plane containing point *T*.

plane *RTQ* plane *VTW* plane $\mathcal{P}$

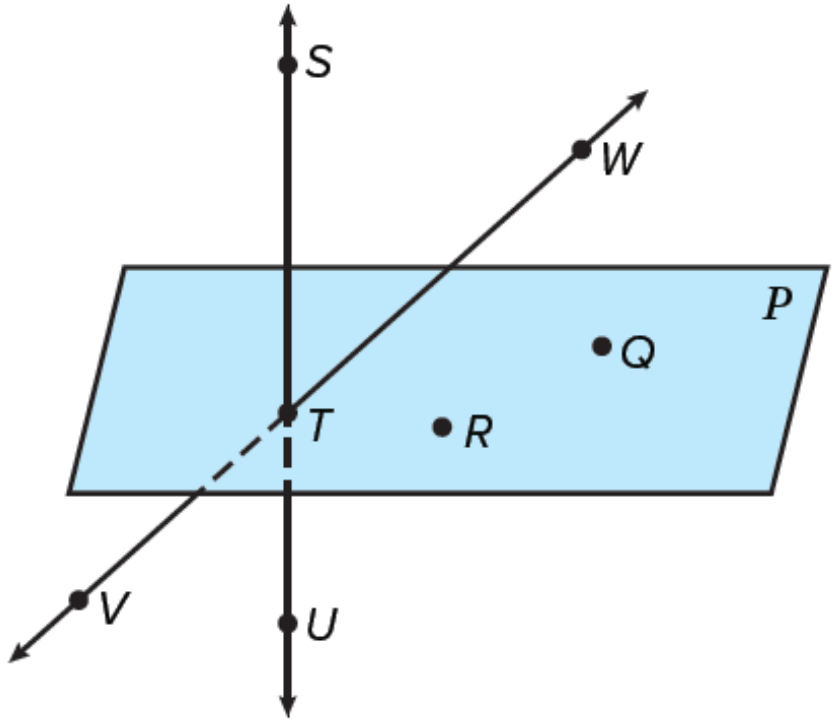
plane *WST* plane *TQR* plane *WTV*

b. a line containing point *U*

Example 1
Name Lines and Planes

Check

Use the figure to name each of the following.



a. Identify the correct names for a plane containing point *T*.

plane *RTQ* plane *VTW* plane $\mathcal{P}$

plane *WST* plane *TQR* plane *WTV*

b. a line containing point *U* $\overleftrightarrow{ST}$ $\overleftrightarrow{TS}$ $\overleftrightarrow{SU}$ $\overleftrightarrow{US}$ $\overleftrightarrow{TU}$ $\overleftrightarrow{UT}$

Learn

Intersections of Lines and Planes

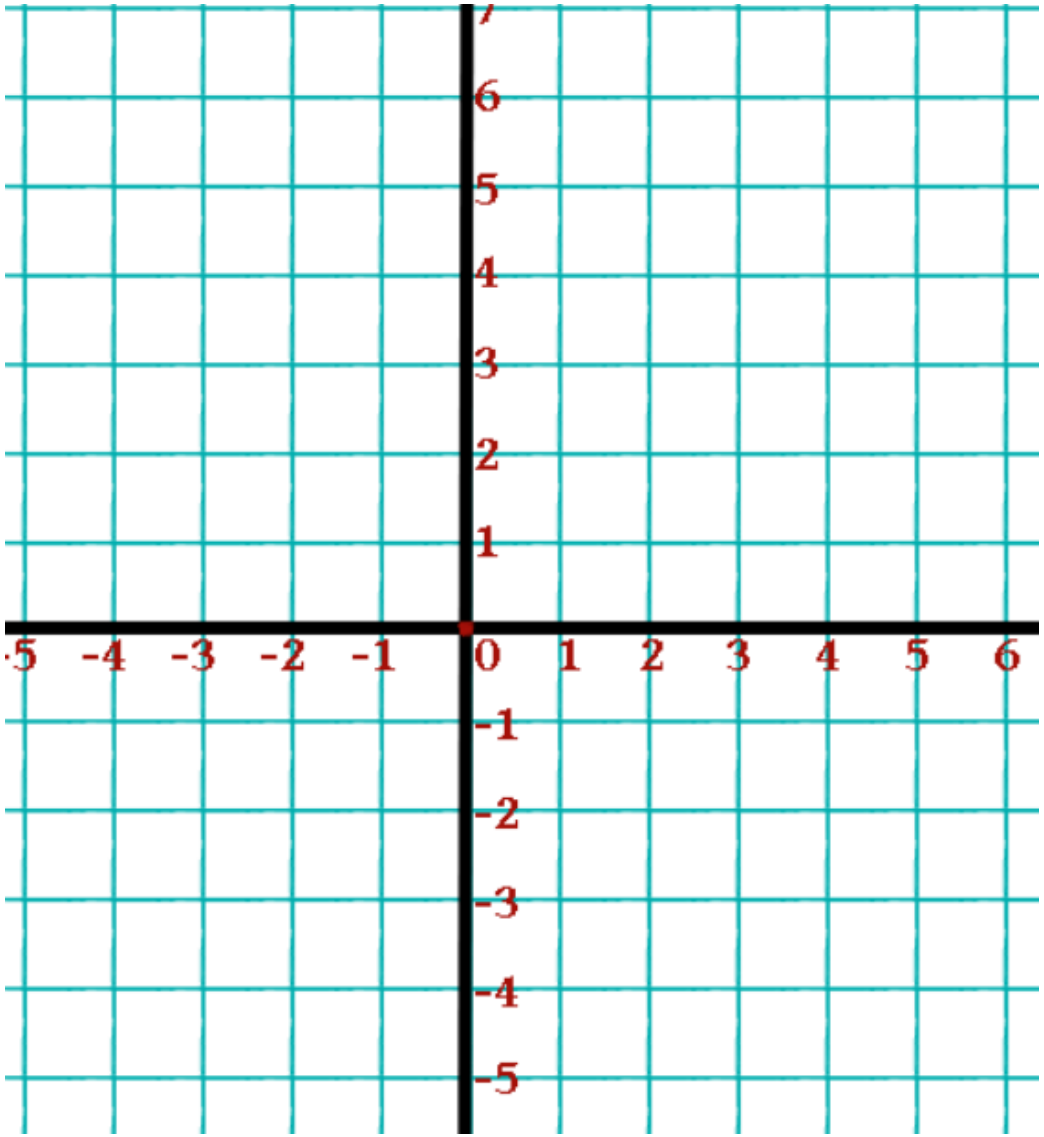
The **intersection** of two or more geometric figures is the set of points they have in common. Two lines intersect in a point. Lines can intersect planes, and planes can intersect each other.

Example 3

Draw Geometric Figures

Draw and label a figure to represent the relationship.

$\overleftrightarrow{QR}$ and $\overleftrightarrow{ST}$ intersect at *U* for *Q*(−3, −2), *R*(4, 1), *S*(2, 3), and *T*(−1, −5) on the coordinate plane. Point *V* is coplanar with these points but not collinear with $\overleftrightarrow{QR}$ and $\overleftrightarrow{ST}$.

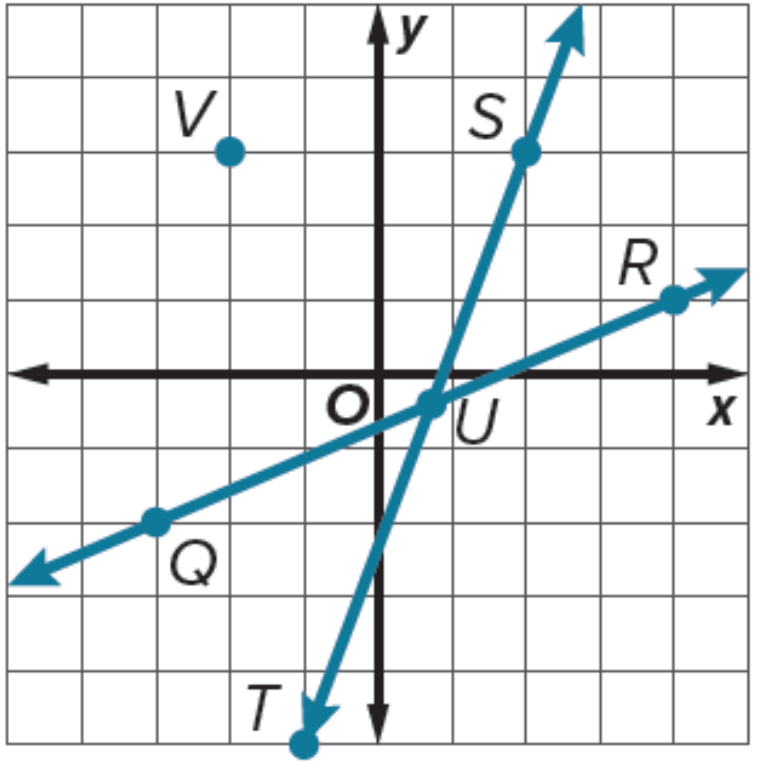


Example 3
Draw Geometric Figures

Graph each point and draw $\overleftrightarrow{QR}$ and $\overleftrightarrow{ST}$.

Label the intersection point as *U*.

An infinite number of points are coplanar with *Q*, *R*, *S*, *T*, and *U* but are not collinear with $\overleftrightarrow{QR}$ and $\overleftrightarrow{ST}$. In the graph, one such point is *V*(−2, 3).

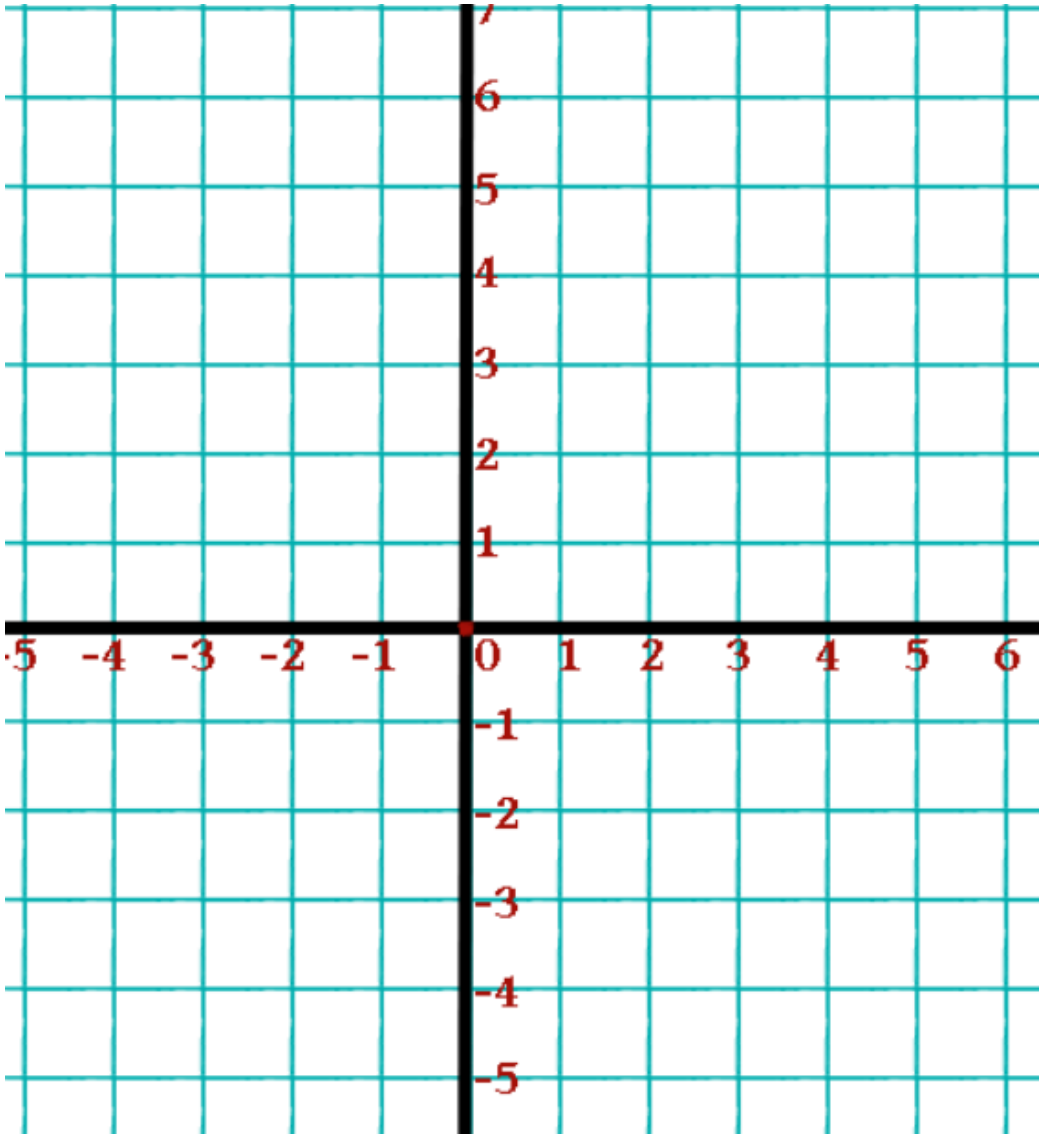


Example 3
Draw Geometric Figures

Check

Draw and label a figure to represent the relationship.

$\overleftrightarrow{JK}$ and $\overleftrightarrow{LM}$ intersect at P for $J(-4, 3)$, $K(6, -3)$, $L(-4, -5)$, and $M(3, 3)$ on the coordinate plane. Point Q is coplanar with these points, but not collinear with $\overleftrightarrow{JK}$ and $\overleftrightarrow{LM}$.



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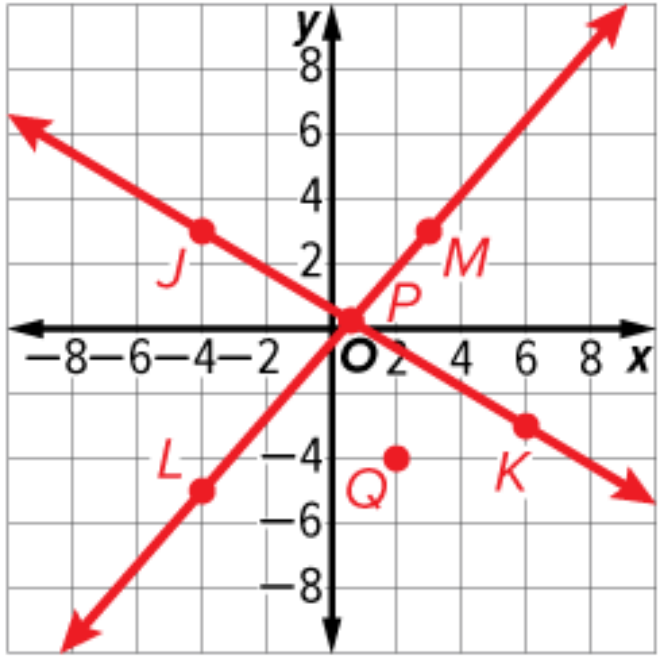


Example 4

Interpret Drawings

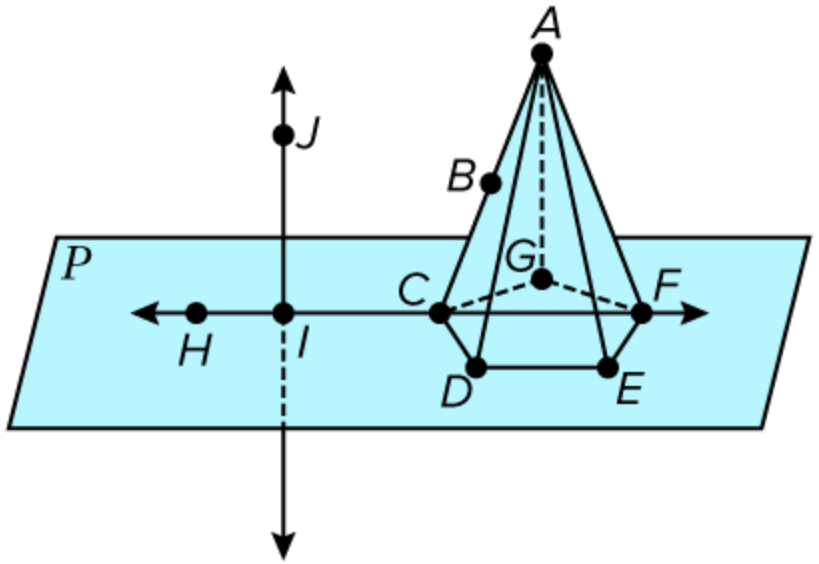
Refer to the figure.

a. How many planes appear in this figure?

b. Name four points that are collinear.

c. Name the intersection of plane *GAC* and plane $\mathcal{P}$.

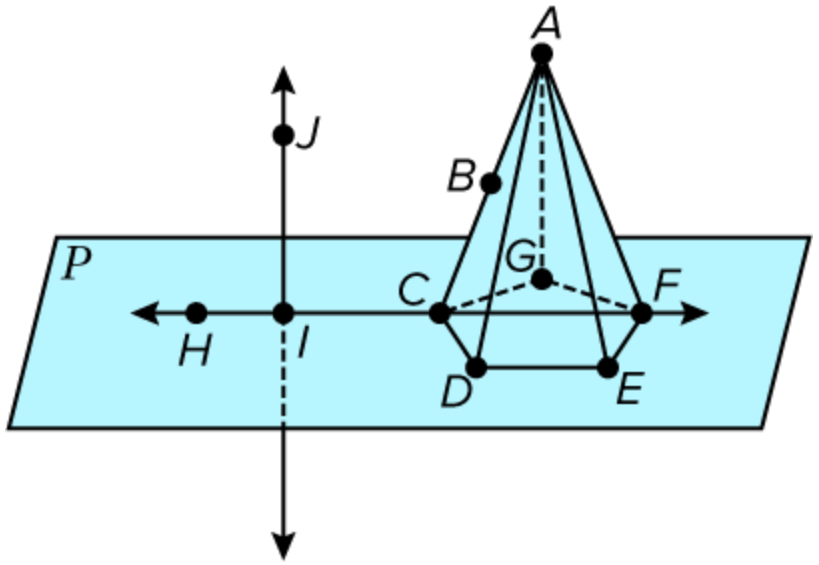
d. At what point do $\overleftrightarrow{JI}$ and $\overleftrightarrow{DC}$ intersect? Explain.



Example 4
Interpret Drawings

a. How many planes appear in this figure?

six: plane $\mathcal{P}$, plane *CAG*, plane *GFA*, plane *EFA*, plane *DEA*, and plane *DCA*



b. Name four points that are collinear.

Points *H*, *I*, *C*, and *F* are collinear.

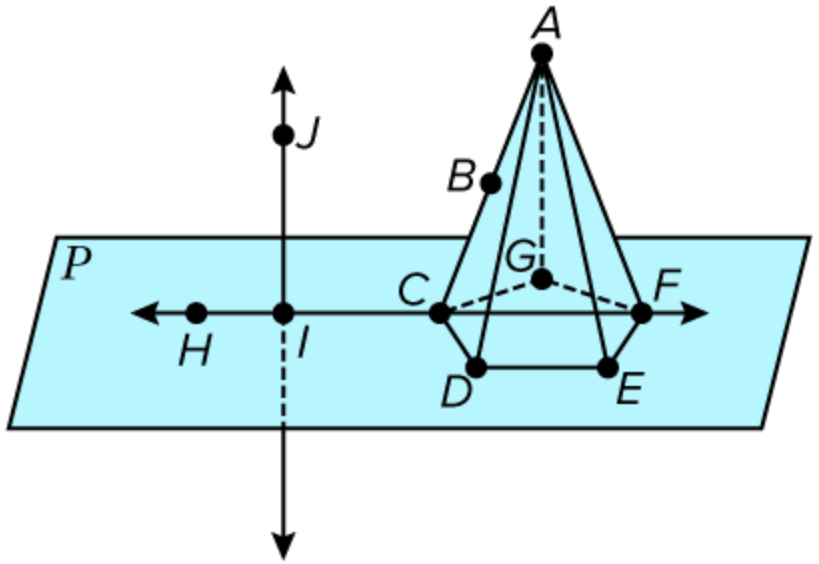
c. Name the intersection of plane *GAC* and plane $\mathcal{P}$.

Plane *GAC* intersects plane $\mathcal{P}$ in $\overleftrightarrow{GC}$.

Example 4
Interpret Drawings

d. At what point do $\overleftrightarrow{JI}$ and $\overleftrightarrow{DC}$ intersect? Explain.

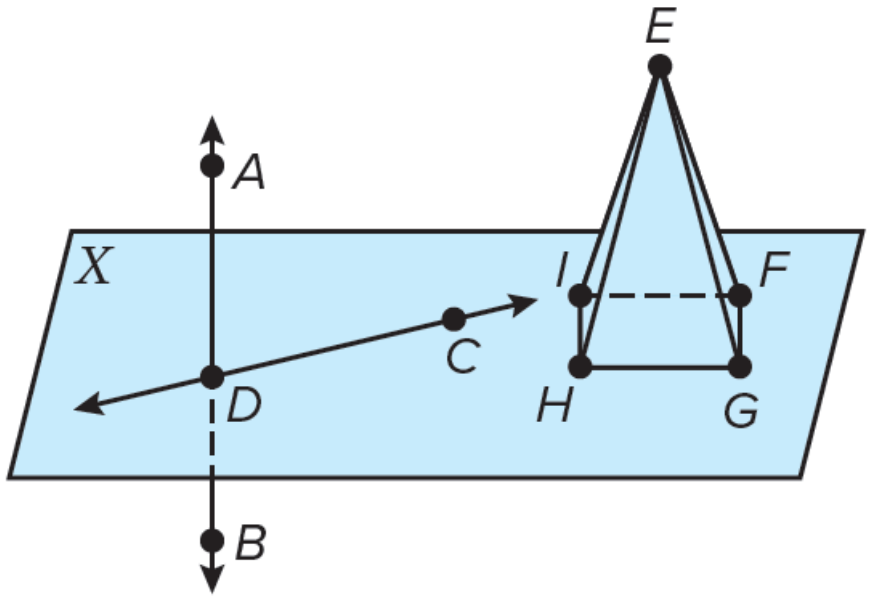
It does not appear that these lines intersect. $\overleftrightarrow{DC}$ lies in plane $\mathcal{P}$, but only point *I* of $\overleftrightarrow{JI}$ lies in plane $\mathcal{P}$.



Example 4
Interpret Drawings

Check

Refer to the figure. Name three points that are collinear.

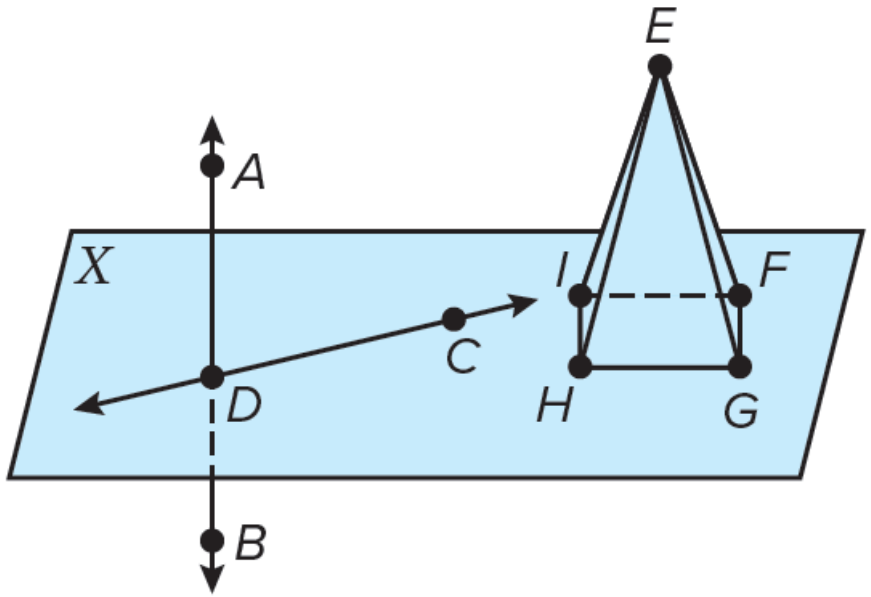


Example 4
Interpret Drawings

Check

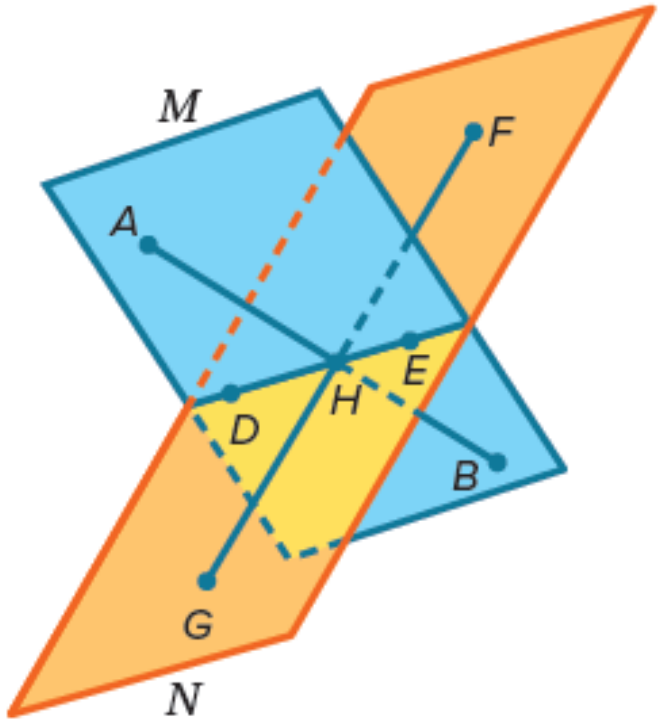
Refer to the figure. Name three points that are collinear.

Points *D*, *A*, and *B* are collinear.



Exit Ticket

Use the figure to answer each question.



1. Name 3 points that are collinear.

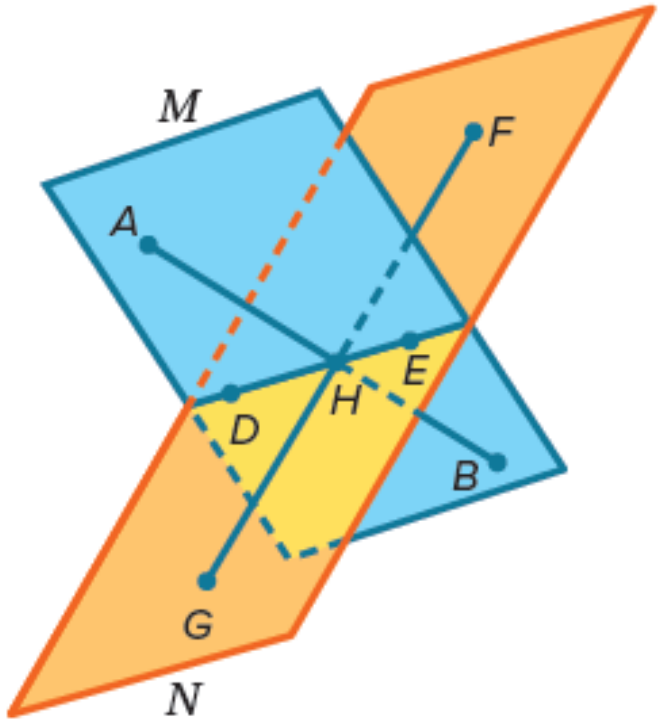
2. Name 3 points that are noncollinear.

3. Name 5 coplanar points in plane *M*.

4. Name a point that lies on the intersection of planes *M* and *N*.

Exit Ticket

Use the figure to answer each question.



1. Name 3 points that are collinear.
A, H, B or *D, H, E* or *F, H, G*

2. Name 3 points that are noncollinear.
Answers will vary.

3. Name 5 coplanar points in plane *M*.
A, B, D, E, H

4. Name a point that lies on the intersection of planes *M* and *N*. *D, E,* or *H*